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Development of one bedroom apartment home appliance control system

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General Note

 Article is recommended to print as color digital version in recycled paper.

ABSTRACT

The automation of home has become important in order to minimize the consumption of electrical energy and for the safety of the home in terms of home appliances. This paper looks at the complete automation of one bed room apartment, where each appliance can be controlled using few switch (five switches) and all the appliances to be controlled will be displayed on a GLCD. The key pad section which is mobile is designed with five switches and a display connected to a microcontroller, and any appliance to be controlled will be searched for, be it in either connected or discounted state. The static section will be at home to control the appliance requested by the remote section (user) to either turn ON or OFF the appliance. The mobile section comprises of PIC18f microcontroller that gets input from five switches (up, down, fwd, bck and menu). These switches are used to manoeuvre to where the appliance is display on the GLCD, then to connect or disconnect is selected and a message is sent to the static section of the controller via GSM module to either turn ON or OFF the appliance.

Keywords: Automation, GLCD, PIC18f, GSM and switches

1. INTRODUCTION

Home automation system is a system which is used to control the appliance at home especially from a remote distance. The use of a GSM in home automation system increases the coverage distance compared to other radio frequency (RF) wireless module but the cost of using credit has limited its cost for regular usage. Global system for mobile communication (GSM) modules is most often used in products for home and industrial applications such as doors openers, wireless alarm or monitoring systems, remote controls for both homes automations and industries, and smart sensor applications. GSM modules have replaced other communication designs such infra-red, Bluetooth and RF modules due their range of coverage. Today, home automation systems are effectively used to make life easier and better. In this project, smart home appliance controller system using GSM technology is used to control the living room appliances and all information's are display on a graphical liquid crystal display (GLCD).

Ahmed et al. (2013) developed an Internet based Embedded System for controlling and monitoring the electrical device at home from anywhere by a specific web application shared on the internet by using standard Local Area Network (LAN) that can be interfaced with Microcontroller.

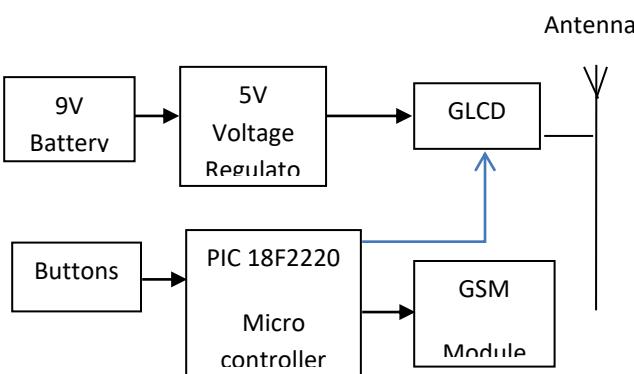
Ming and Hao (2013) developed a Bluetooth-based android smartphone for home lighting control system. The App to control the lighting points was design using android software which was installed in a smart phone. Using the Bluetooth of the smart phone the lighting points can now be controlled by the installed App,

Aniket et al. (2015) developed a real-time low-cost home automation system using an embedded controller (ATMEGA328 controller board) interfaced with RTOS, power plugs, light switches, and temperature sensor to demonstrate the effectiveness and feasibility of their proposed smart home system.

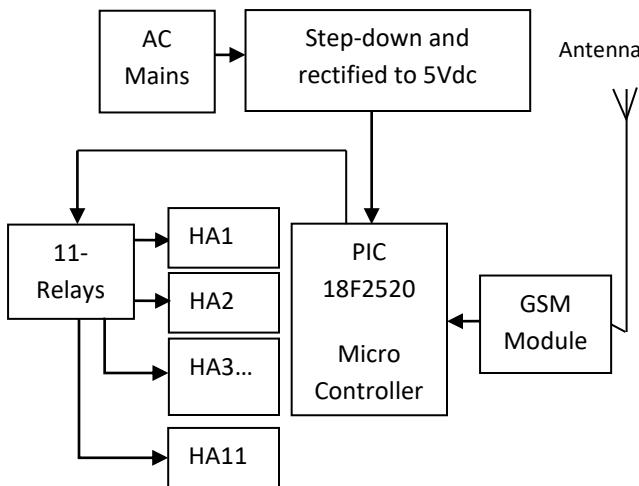
2. DEVELOPMENT OF BLOCK DIAGRAM

The figure 1 shows the block diagram of the one bedroom apartment home appliance controller system which comprises of two sections; Figure 1a is the remote controller (mobile) unit and Figure 1b is the controlled (static) unit. At the remote controller (mobile) unit the buttons sends information's to the Microcontroller that uses these information's to generate serial signals which transmitted via GSM module (GSM900 datasheet, 2018) and also displayed messages or icons on the GLCD (GLCD datasheet, 2017). The controlled (static) unit receives the transmitted serial signal via another GSM module connected to another microcontroller. This microcontroller receives this serial signal and compares this serial data with a store data and executes the data if it matches any of the data stored in the memory of the microcontroller by turning ON or OFF a relay(s) that corresponds to that data. In this design eleven loads (Home Appliances) are to be controlled via relay.

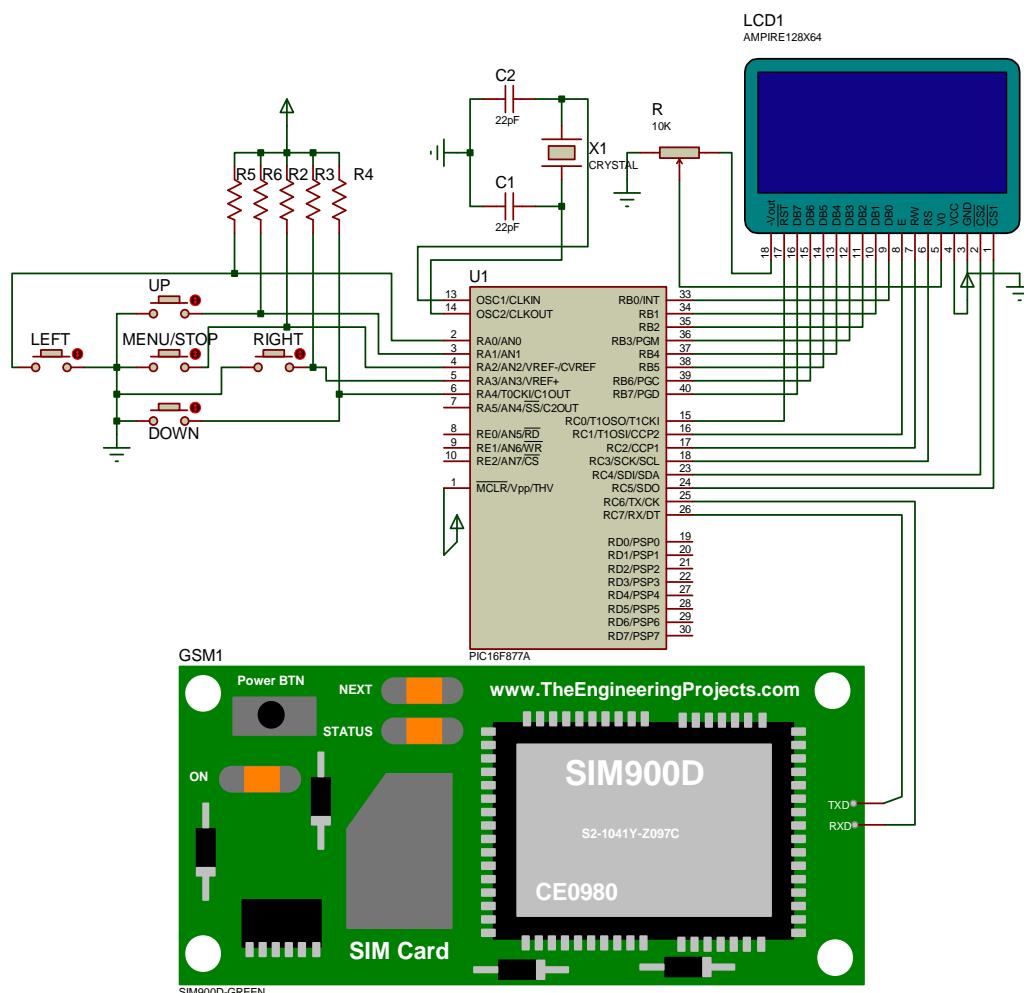
Figure 2 shows the circuit diagram of the one bedroom apartment home appliance controller system. The PIC 18F4525 (PIC18F4525 datasheet, 2016) microcontroller at the remote controller (mobile) unit circuit scans for the menu button to be pressed after initializing. When the menu button is pressed, the microcontroller gives command for the GLCD to display the appliances to be controlled. When the appliance is selected another menu opens to the user to select which room is the appliance, when the room is selected, another menu opens again to either turn ON or OFF the appliance. This signal will be sent via GSM module to the second GSM module at the controlled (static) unit which sends the signal to the microcontroller PIC18F4525 which then compares the received data and executes the information by turning ON or OFF the relay that corresponds to the appliance.



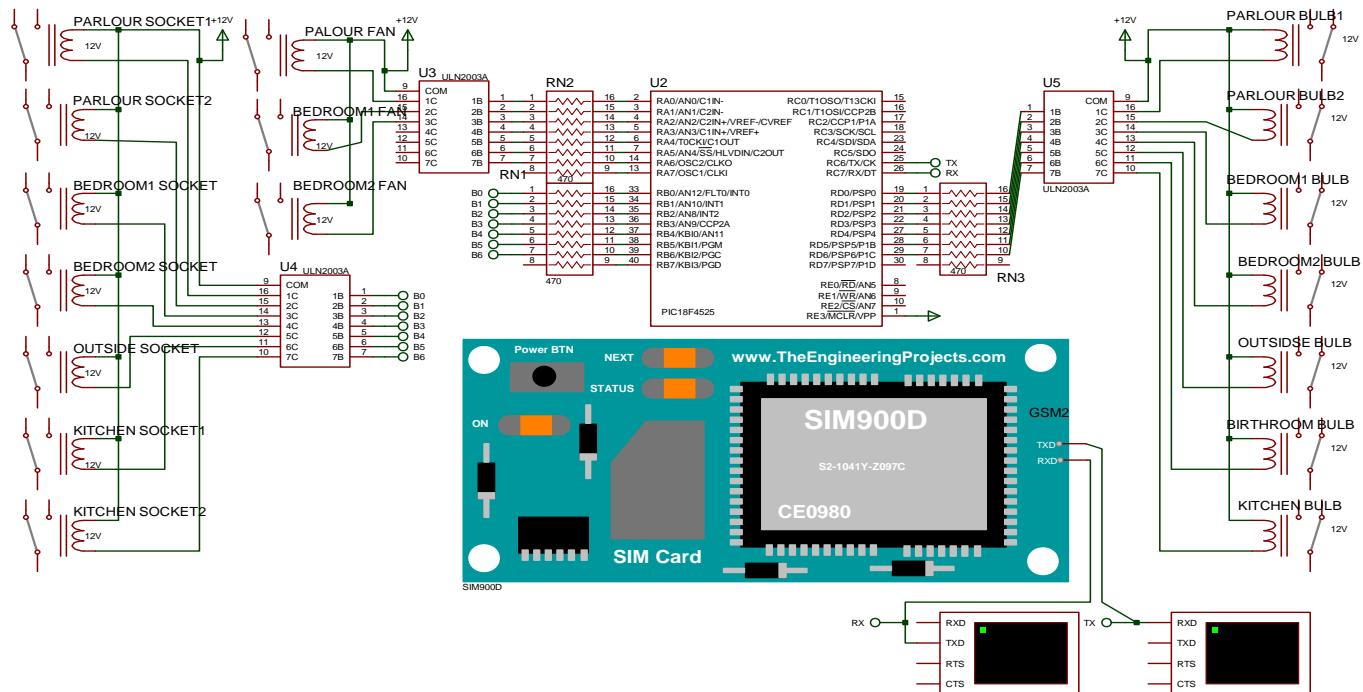
(a): Block Diagram of remote controller (mobile) unit



(b): block diagram of controlled (static) unit

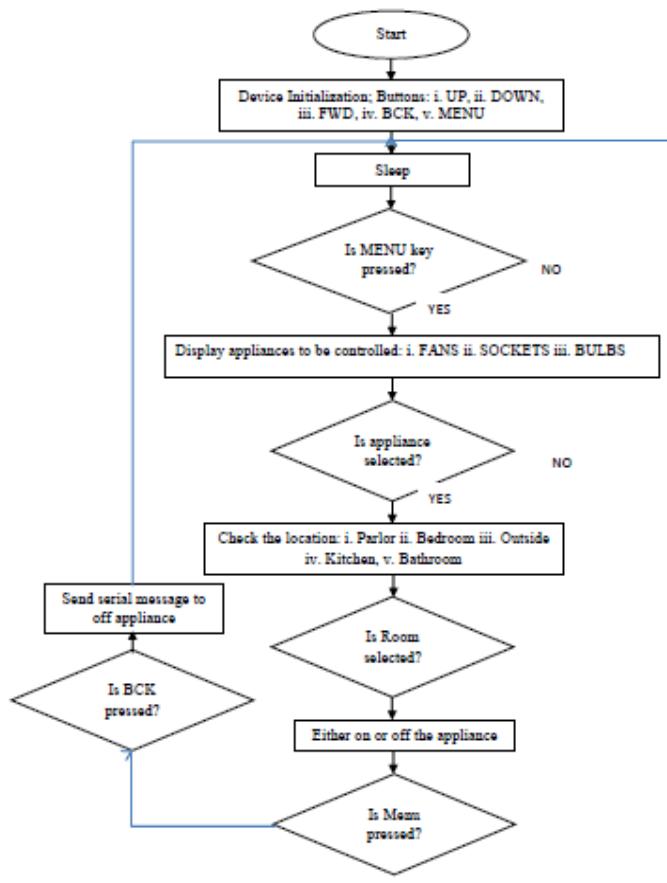
Figure 1: Block diagram of one bedroom apartment home appliance controller system

(a): Circuit Diagram of the remote controller (mobile) unit

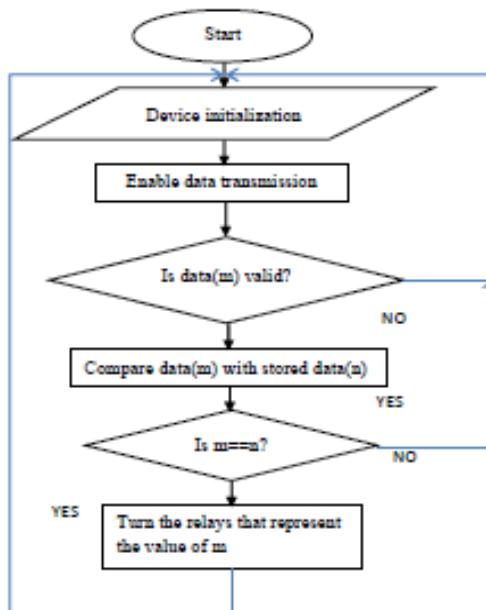


(b): Circuit Diagram of the controlled (static) unit

Figure 2: Schematic circuit diagram for the sending unit and the control unit of the one-bedroom apartment home appliance controller system



(a) Remote controller flow chart



(b) Receiver/control section flow chart

Figure 3: flow chart of the two bedroom apartment home appliance controller system

Figure 3a depicts the flow chart of the remote controller unit when the device is turned ON, it starts and then proceeds for initialization and maintains the sleep mode to ensure proper synchronism. Whenever a button is pressed it proceeds to identify the key pressed, else it will return back to sleep mode if no key is pressed. After identifying the key that is pressed, it confirms its validation and updates its status with GLCD confirming it; it then proceeds to check the timer and then validates the data if true. If the data isn't valid, the process returns back to the decision mode that requires any key to be pressed. If device is left for a long time, it returns back to sleep mode but still maintains its condition as last seen. While Figure 3b shows the receiver/control section flow chart when the device is turned ON, it starts and then proceeds to the initialization stage; and maintains the sleep mode to ensure proper synchronism. When the first synchronization is achieved, the reset button is pressed to ensure maximum uniform timing with remote control section else it will return back to sleep mode. The status is displayed on the screen of the GLCD. If the data received and transmitted is valid, it will proceed to send command switch on.

3. RESULTS AND DISCUSSION

The program for the microcontroller was written in C language and was then compiled into an executable file using the mickro C IDE [13]. The executable file was next imported into the Proteus Design Suite IDE [14] where the hardware circuit was designed and simulated as shown in Figure 2. Figures 4 to 13 show the implemented results of the one bedroom apartment home appliance controller system.



(a): First page display



(b): Modem configuration



(c): Modem ready



(d): Menu to start control

Figure 4: Initialization of the remote controller unit

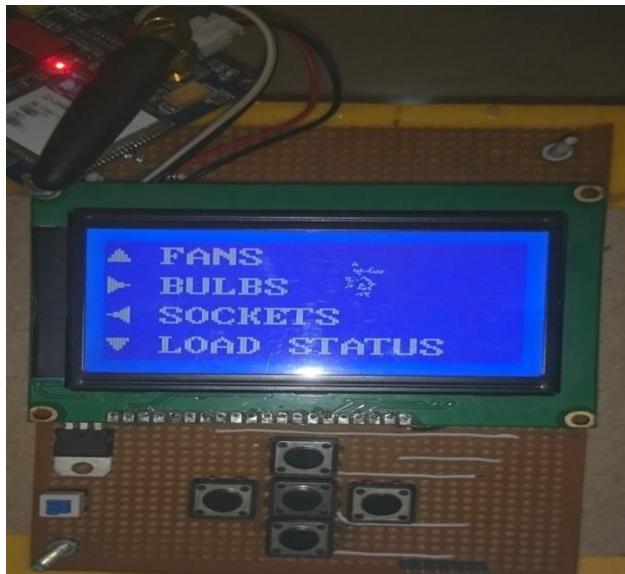


Figure 5: Display of Loads to be controlled



Figure 6: When fan is selected and bedroom fan is selected



Figure 7: When fan is selected and parlour fan is selected



Figure 8: When fan is selected and dinning fan is selected



Figure 9: When sending the state of the bedroom fan either to turn it ON or OFF

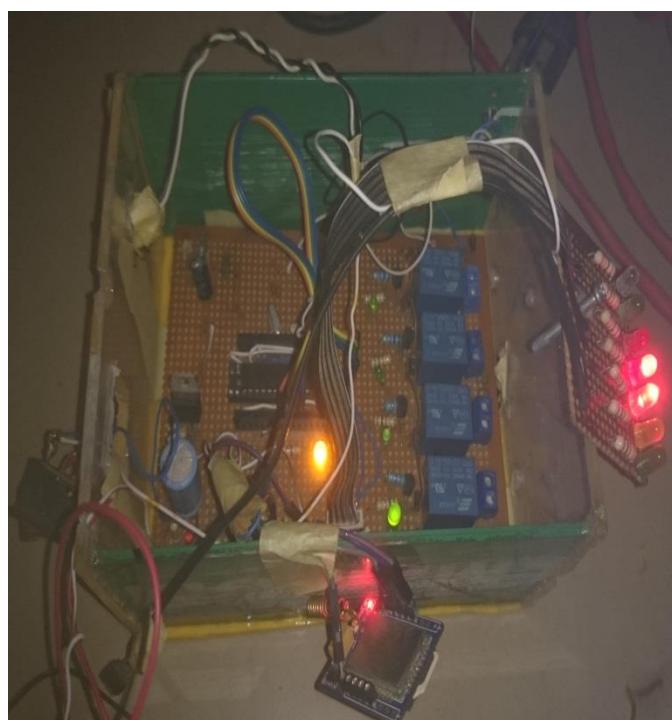


Figure 10: The controller unit turns ON the bedroom fan relay to turn ON the fan



Figure 11: When status off the apartment is requested for



Figure 12: When wrong request is made by message from somewhere else

4. DISCUSSION

Figure 4 shows the initialization processes especially, since the GSM needs time to initialize. Figure 4d displays the menu after initialization has ended. When the menu button (the middle button) is pressed, the loads to be controlled will be display. The other button represents a controller to be controlled; up (Δ) for fans, right (\rightarrow) for bulbs, left (\leftarrow) for sockets and down (∇) for loads status. When the up button is pressed figure 6 will display. The up and down button indicates that we can either move up or down to locate the room of the fan. In figure 6, bedroom is selected, where the dot (\bullet) symbol is selects.



(a): Display of first information about the status



(b): Display of second information about the status



(c): Display of first information about the status



(d): Display of first information about the status



(e) Display of first information about the status

Figure 13: Display of request status of the one-bedroom apartment.

In Figure 7, parlour is selected and figure 8, bedroom is selected. Selection is done using the menu button as shown in figure 9, where bedroom has the option to either turn it ON or OFF. Using the up or down button we can now turn ON or Off the fan in the bedroom and a message will be send to the controlled unit to either turn ON or OFF the relay controlling the fan in the bedroom. Figure 10 shows the controller unit where four relays with LEDs to indicate when the relays are on or off and other eight load relay represent with eight LEDs instead.

Figure 11 shows when the load status button is pressed from the remote controller unit, the controlled unit sends the status of each load back to the remote controller unit has shown in figure 13., but if a message is sent to the remote controllers and it is not from the controller unit "invalid mes" will be displayed as shown in figure 12. Figure 13a displays the fans status, using the menu button, other load status can be view as shown in figure 13b to 13e. One can either turn ON or OFF any load in the apartment using the remote controller unit as long as there is GSM network and can get the status of the entire load in the apartment to know which is on or off.

5. CONCLUSION

In this paper, a remote control for multiple home appliances controller was designed and implemented to achieve the goal to ON and OFF any appliance in a one-bedroom apartment. The GSM module provides an unlimited range to control any appliances without the close requirement of location or line of sight. The relay action which is connected to the load is controlled only when the signals transmitted via GSM module when the switch(s) is pressed. This paper has presented a means of switching appliances without necessarily being present this makes the system is very marketable project because of its simplicity, affordability, portability and low power consumption.

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Conflict of Interest

The authors declare that there are no conflicts of interests.

Peer-review

External peer-review was done through double-blind method.

Data and materials availability

All data associated with this study are present in the paper.

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